Idaho K-12 Content Standards for Computer Science

The Computer Science standards build upon frameworks developed by professional organizations, educators, and industry. In particular, they build upon the 2016 ~~draft~~ interim standards put out by CSTA (Computer Science Teachers Association). ~~This document~~ It is not an exhaustive list of everything in computer science that can be learned within a K-12 pathway, but instead, the work below outlines what it means to be literate in Computer Science. Curriculum developers are encouraged to create a learning experience that extends beyond the framework to encompass students' many interests, abilities, and aspirations. ~~The framework reflects the latest research in CS education, including learning progressions, trajectories, and computational thinking.~~

The standards also aligns with the draft version of the k-!2 Computer Science Framework (2016). The framework reflects the latest research in CS education, including learning progressions, trajectories, and computational thinking. ~~The CSTA draft standards were created by several states (MD, CA, IN, IA, AR, UT, ID, NE, GA, WA, NC), large school districts (NYC, Chicago, San Francisco), technology companies (Microsoft, Google, Apple), organizations (Code.org, ACM, CSTA, ISTE, MassCAN, CSNYC), and individuals (university faculty, researchers, K-12 teachers, and administrators). They align with the K-12 CS Education Framework (https://k12cs.org) that is steered by 5 organizations: ACM (Association for Computing Machinery), CIC (Cyber Innovation Center), Code.org, CSTA, and NMSI (National Math+Science Initiative). The K-12 CS framework provides overarching, high level guidance per grade bands, while the standards provide detailed student performance expectations at particular grade levels.~~ The K-12 Computer Science Framework was steered by five organizations: Association for Computing Machinery, Code.org, Computer Science Teachers' Association, Cyber Innovation Center, and National Math and Science Initiative; several states (MD, CA, IN, IA, AR, UT, ID, NE, GA, WA, NC), large school districts (NYC, Chicago, San Francisco); technology companies (Microsoft, Google, Apple); and Individuals (university faculty, researchers, K-12 teachers, and administrators).

What is Computer Science?

Computer Science is an established discipline at the collegiate and post-graduate levels. It is best defined as "the scientific and engineering approach to computation, as well as its applications and impact. It is the systematic study of the feasibility, structure, expression, and mechanization of the methodical procedures (or algorithms) that underlie the acquisition, representation, processing, storage, communication of, and access to information." [1] We will use the following concepts and practices from the K-12 CS Education Framework to structure the standards.

The five *Core Computer Science* concepts:
1. ~~Devices~~ Computing Systems
2. Networks and Communication
3. Data and Analysis
4. Algorithms and Programming
5. Impact of Computing

The seven *Computational Thinking Framework Practices*:
1. ~~Designing and Representing~~ Recognizing and Defining Computational Problems
2. Developing and using Abstractions
3. Creating Computational Artifacts
4. Testing and ~~Iteratively~~ Refining Computational Artifacts
5. Fostering an Inclusive Computing Culture
6. Communicating about Computing

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7. Collaborating around Computing

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International Society for Technology Education (ISTE Standards):
1. Creativity and Innovation
2. Communication and Collaboration
3. Research and Information Fluency
4. Critical Thinking, Problem Solving, and Decision Making
5. Digital Citizenship
6. Technology Operations and Concepts

Navigating the Idaho Content Standards for Computer Science

The Idaho Content Standards for Computer Science is a set of learning standards that provide a foundation for a comprehensive K-12 Computer Science curriculum. The standards are organized by grade bands (K-2, 3-5, K-5, 6-8, 9-10, 11-12 and 9-12) and the five Core Computer Science Concepts as referred to by the K-12 CS Education Framework (https://k12cs.org). It is intentional that some of the grade bands overlap. An item code is designated to facilitate the ease of locating and identifying specific standards based on the grade band (e.g. K-2), the abbreviated core concept (e.g. D-Devices), and the ordered number in the sequence (e.g. K-2.D.1). The seven Computational Thinking Framework Practices are included to frame the different standards. Also included is a column for the designation of ISTE (International Society for Technology Education) Standards as they align with the content standards for Computer Science.

The standards are not curriculum. Curriculum is determined by the local school districts. The standards clarify the learning outcomes of students. The standards inform teachers of what students should know, understand, and be able to do. Teachers can create "I can" statements with student friendly language from the standards. The examples listed within the standards are intended to be suggestions and provide clarification for teachers; they are not intended to be a menu, prescriptive, or all inclusive. While these standards set a foundation of learning statewide, local school districts in Idaho have the discretion to expand expectations of student learning beyond the state standards. Educators can use the standards in a variety of creative ways.

Once standards are introduced and mastered, they become prerequisites and are intended to be included in the curriculum at advanced grade levels. For example, the standard 6-8.D.04 (troubleshooting software and hardware) introduced in Grades 6-8 isn't explicitly repeated at higher grades as the students will continue to practice the skills identified in this standard at higher grade levels. At the high school level, the learning objectives appropriate for all students at this level are included in *Grades 9-10*. Some students will opt for additional, more rigorous elective Computer Science courses in high school. The objectives appropriate for the subset of high school students focusing more deeply in Computer Science are listed in level *Grades 11-12*.

The standards written for grade bands K-2, 3-5, K-5, and 6-8, have been written with the intent that they can be incorporated into existing classes and subject areas relevant to each grade band and do not necessitate the creation of a specific Computer Science course to address the standards. However, this does not preclude local school districts from choosing to create specific Computer Science courses or units at these levels. At the high school level, we expect most local school districts will create standalone Computer Science courses. Two nationally recognized high school courses that are worth mentioning as models are *Exploring Computer Science* (http://www.exploringcs.org) and *AP Computer Science Principles* (http://apcsprinciples.org). These courses don't cover all of the proposed high school standards, but they can serve as model courses for local school districts to adapt to their unique environments.

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	K-12 CS Standards - (D) Computing Systems (CS) The student will be able to:	Computational Thinking Framework Practice	ISTE Standard
K-2.D CS.01	Locate and identify computing, input, and output devices in a variety of environments (e.g., desktop and laptop computers, tablets, mobile devices, monitors, keyboards, mouse, printers). (Grades K-2)	Communicating about Computing	*Technology operations and concepts
K-2.D CS.02	Demonstrate how to operate a variety of computing devices (e.g., turn on, navigate, open/close programs or apps). (Grades K-2)	Communicating about Computing	*Technology operations and concepts
K-2.D CS.03	Recognize that software is required to control all computing devices (e.g., programs, browsers, websites, apps). (Grades K-2)	Communicating about Computing	*Technology operations and concepts
K-2.D CS.04	Identify, using accurate terminology, simple hardware and software problems and apply strategies for solving these problems (e.g., rebooting the device, checking the power, access to the network, reading error messages, discussing problems with peers and adults). (Grades K-5)	Testing and Iteratively Refining Computational Artifacts	*Critical thinking, problem solving, and decision making *Technology operations and concepts
3-5.D CS.01	Create code to model intelligent behavior in computing devices (e.g., CS unplugged activities, robot programming). (Grades 3-5)	Creating Computational Artifacts	*Creativity and innovation
3-5.D CS.02	Identify, using accurate terminology, simple hardware and software problems and apply strategies for solving these problems (e.g., rebooting the device, checking the power, access to the network, reading error messages, discussing problems with peers and adults). (Grades K-5)	Testing and Iteratively Refining Computational Artifacts	*Critical thinking, problem solving, and decision making *Technology operations and concepts
6-8.D CS.01	Exemplify how computational devices impact the quality of life (both positively and negatively) and enhance the ability of people to perform work, communicate, and interact with others. (Grades 6-8)	Fostering an Inclusive Computing Culture	*Communication and collaboration *Digital citizenship
6-8.D CS.02	Compare and contrast the ways that humans and machines process instructions and sense the world. (Grades 6-8)	Developing and using Abstractions	*Critical thinking, problem solving, and decision making
6-8.D CS.03	Differentiate features of everyday objects that contain computing components (e.g., devices that collect, store, analyze, and/or transmit data, such as Kinect, GoPro, smartphone, or car). (Grades 6-8)	Developing and using Abstractions	*Research and information fluency
6-8.D CS.04	Apply troubleshooting strategies for solving hardware and software problems (e.g., recognizing, describing, reproducing, isolating, fixing and retesting). (Grades 6-8)	Testing and Iteratively Refining Computational Artifacts	*Creativity and innovation *Critical thinking, problem solving, and decision making *Technology operations and concepts
6-8.D CS.05	Compare and contrast the capabilities of different hardware and software in computer	Communicating about Computing	*Technology operations and

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	systems (e.g., processors, display types, input devices, communication, and storage capabilities). (Grades 6-8)		concepts
9-10.~~D~~ CS.01	Identify and evaluate what computing resources are required for a given purpose (e.g., system requirements needed to run a program, hardware, and software needed to run game X). (Grades 9-10)	Fostering an Inclusive Computing Culture	*Creativity and innovation *Research and information fluency *Critical thinking, problem solving, and decision making *Technology operations and concepts
9-10.~~D~~ CS.02	Explore the unique features of embedded computers in areas such as mobile devices, sensors, and vehicles. (Grades 9-10)	Fostering an Inclusive Computing Culture	*Creativity and innovation *Research and information fluency *Critical thinking, problem solving, and decision making *Technology operations and concepts
9-10.~~D~~ CS.03	Create or modify a program that uses different forms of input and output. (e.g., use voice input instead of text input, use text-to-speech for output) (Grades 9-10)	Creating Computational Artifacts	*Creativity and innovation *Research and information fluency *Critical thinking, problem solving, and decision making *Technology operations and concepts
9-10.~~D~~ CS.04	Demonstrate the multiple levels of abstraction that support program execution including programming languages, translations, and low level systems including the fetch-execute cycle (e.g., model, dance, create a play/presentation). (Grades 9-10)	Developing and using Abstractions	*Creativity and innovation *Communication and collaboration *Critical thinking, problem solving, and decision making *Technology operations and concepts
11-12.~~D~~ CS.01	Identify and describe hardware (e.g., physical layers, logic gates, chips, components). (Grades 11-12)	Communicating about Computing	*Critical thinking, problem solving and decision making *Technology operations and concepts
11-12.~~D~~ CS.02	Create a model of how embedded systems sense, process, and actuate in a given environment (e.g. ocean, atmosphere, and highway) (Grades 11-12)	Communicating about Computing	*Critical thinking, problem solving and decision making *Technology operations and concepts

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	K-12 CS Standards - Data and Analysis (DA) *The student will be able to:*	Computational Thinking Framework Practice	ISTE Standard
K-2.DA.01	Classify and sort information into useful order without using a computer (e.g., sort objects by various attributes). (Grades K-2)	Fostering an Inclusive Computing Culture	*Research and information fluency
K-2.DA.02	Demonstrate that computing devices save information as data that can be stored, searched, retrieved, modified, and deleted. (Grades K-2)	Developing and using Abstractions	*Research and information fluency *Technology operations and concepts
K-2.DA.03	Explain that networks, like the Internet, link people using computers and other computing devices allowing them to communicate, access, and share information. (Grades K-2)	Developing and using Abstractions	*Communication and collaboration *Technology operations and concepts
3-5.DA.01	Use outcome data (results) from running a simulation to solve a problem or answer a question in a core subject area, either individually or collaboratively. (Grades 3-5)	~~Designing and Representing~~ Recognizing and Defining Computational Problems	*Communication and collaboration *Critical thinking, problem solving and decision making
3-5.DA.02	Understand how computers encode and store data (e.g., simple mapping of binary number to decimal number, letter, or color). (Grades 3-5)	Developing and using Abstractions	*Communication and collaboration *Technology operations and concepts
3-5.DA.03	Gather, manipulate, and evaluate data to explore a real world problem that is of interest to the student. (Grades 3-5)	~~Designing and Representing~~ Recognizing and Defining Computational Problems	*Research and information fluency *Critical thinking, problem solving, and decision making
6-8.DA.01	Describe the trade-off between quality and file size of stored data (e.g., music, video, text, images). (Grades 6-8)	Communicating about Computing	*Technology operations and concepts
6-8.DA.02	Defend the selection of the data, collection, and analysis needed to answer a question. (Grades 6-8)	Communicating about Computing	*Communication and collaboration *Research and information fluency *Critical thinking, problem solving, and decision making
6-8.DA.03	Understand that data collection is used to make recommendations to influence decisions as well as to predict behavior. List the positive and negative impacts. (Grades 6-8)	Fostering an Inclusive Computing Culture	*Research and information fluency *Critical thinking, problem solving, and decision making

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6-8.DA.04	Encode and decode information using encryption/decryption schemes. (e.g., Morse code, Unicode, binary, symbols, student created codes, simple ciphers). (Grades 6-8)	Developing and using Abstractions	*Technology operations and concepts
6-8.DA.05	Identify layers of abstraction in different contexts (e.g., video and animation are made of audio and video frames, which are made of pixels, which are made of color codes). (Grades 6-8)	Developing and using Abstractions	*Critical thinking, problem solving, and decision making *Technology operations and concepts
9-10.DA.01	Illustrate how various types of data are stored in a computer system (e.g., how sound and images are stored). (Grades 9-10)	Communicating about Computing	*Communication and collaboration *Critical thinking, problem solving, and decision making *Technology operations and concepts
9-10.DA.02	Differentiate between information access and distribution rights. (Grades 9-10)	Communicating about Computing	*Communication and collaboration *Critical thinking, problem solving, and decision making *Digital citizenship *Technology operations and concepts
9-10.DA.03	Compare and contrast the viewpoints on cybersecurity from the perspective of security experts, privacy advocates, the government (e.g., persuasive essay, presentation, or debate). (Grades 9-12)	Fostering an Inclusive Computing Culture	*Communication and collaboration *Critical thinking, problem solving, and decision making *Digital citizenship
9-10.DA.04	Explain the principles of security by examining encryption, cryptography, and authentication techniques. (Grades 9-12)	~~Designing and Representing~~ Recognizing and Defining Computational Problems	*Critical thinking, problem solving, and decision making *Digital citizenship
9-10.DA.05	Apply basic techniques for locating, collecting, and understanding the quality of small and large-scale data sets (e.g., public data sets). (Grades 9-10)	Designing and Representing Computational Problems	*Research and information fluency *Technology operations and concepts
9-10.DA.06	Convert between binary, decimal, octal, and hexadecimal representations of data. (Grades 9-10)	Developing and using Abstractions	*Research and information fluency *Technology operations and concepts

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9-10.DA.07	Analyze the representation and trade-offs among various forms of digital information (e.g., lossy versus lossless compression). (Grades 9-10)	Developing and using Abstractions	*Research and information fluency *Critical thinking, problem solving, and decision making *Technology operations and concepts

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			concepts
9-10.DA.08	Analyze data and identify patterns through modeling and simulation.(Grades 9-12)	Developing and using Abstractions	Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
11-12.DA.01	Use data analysis to enhance understanding and gain knowledge of complex systems to show the transformation from data to information to knowledge (e.g., using existing data sets). (Grades 11-12)	Fostering an Inclusive Computing Culture	Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
11-12.DA.02	Use various data collection techniques for different types of problems (e.g., mobile device GPS, user surveys, embedded system sensors, open data sets, social media data sets). (Grades 11-12)	Fostering an Inclusive Computing Culture	Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
11-12.DA.03	Understand and explain security policies by comparing encryption and authentication strategies (e.g., trapdoor functions and man in the middle attacks). (Grades 11-12)	~~Designing and Representing~~ Recognizing and Defining Computational Problems	Creativity and innovation ◦ Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
11-12.DA.04	Discuss the variety of interpretations of binary sequences (e.g., instructions, numbers, text, sound, image). (Grades 11-12)	Developing and using Abstractions	Technology operations and concepts
11-12.DA.05	Use models and simulations to help formulate, refine, and test scientific hypotheses. (Grades 11-12)	Developing and using Abstractions	Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
11-12.DA.06	Analyze data and identify patterns through modeling and simulation.(Grades 9-12)	Developing and using Abstractions	Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Technology

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			operations and concepts

	K-12 CS Standards - Impact of Computing (IC) *The student will be able to:*	Computational Thinking Framework Practice	ISTE Standard
K-2.IC.01	Practice responsible digital citizenship (legal and ethical behaviors) in the use of technology systems and software. (Grades K-5)	Fostering an Inclusive Computing Culture	Digital citizenship
K-2.IC.02	Understand that a wide range of jobs require knowledge or use of computer science. (Grades K-2)	Fostering an Inclusive Computing Culture	Research and information fluency
3-5.IC.01	Practice responsible digital citizenship (legal and ethical behaviors) in the use of technology systems and software. (Grades K-5)	Fostering an Inclusive Computing Culture	Digital citizenship
3-5.IC.02	Explore the connections between computer science and other fields. (Grades 3-5)	Fostering an Inclusive Computing Culture	Research and information fluency ◦ Critical thinking, problem solving, and decision making
3-5.IC.03	Generate examples of how the use of computing can affect society and how society can influence the use of computing. (Grades 3-5)	Fostering an Inclusive Computing Culture	Communication and collaboration
3-5.IC.04	Explain ethical issues that relate to computers and networks (e.g., equity of access, security, privacy, copyright, digital citizenship, and intellectual property). (Grades 3-5)	Fostering an Inclusive Computing Culture	Digital citizenship
3-5.IC.05	Evaluate the positive and negative impacts of computing devices in daily life. (e.g., downloaded videos and audio files, electronic appliances, wireless Internet, mobile computing devices, GPS systems, Internet of Things, wearable computing). Describe the pros and cons of these impacts.(Grades 3-5)	Fostering an Inclusive Computing Culture	Digital citizenship
6-8.IC.01	Explore security risks associated with using weak passwords, lack of encryption, and/or insecure transactions. (Grades 6-8)	Communicating about Computing	Critical thinking, problem solving, and decision making ◦ Digital citizenship ◦ Technology operations and concepts
6-8.IC.02	Explore how computer science fosters innovation and enhances other careers and disciplines. (Grades 6-8)	Communicating about Computing	Creativity and innovation ◦ Research and information

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			fluency ◦ Technology operations and concepts
6-8.IC.03	Describe ethical issues that relate to computers and networks (e.g., equity of access, security, privacy, ownership and information sharing, copyright, licensing). (Grades 6-8)	Fostering an Inclusive Computing Culture	Creativity and innovation ◦ Research and information fluency ◦ Digital Citizenship ◦ Technology operations and concepts
6-8.IC.04	Explore how the Internet impacts global communication and collaboration. (Grades 6-8)	Fostering an Inclusive Computing Culture	Creativity and innovation ◦ Communication and collaboration
6-8.IC.05	Design, develop, and present computational artifacts that have a positive social impact (e.g. web pages, mobile applications, animations). (Grades 6-8)	Creating Computational Artifacts	Creativity and innovation ◦ Communication and collaboration ◦ Critical thinking, problem solving, and decision making
6-8.IC.06	Redesign user interfaces (e.g., web pages, mobile applications, animations) to be more inclusive, accessible, and minimizing the impact of the designer's inherent bias. (Grades 6-8)	Testing and ~~Iteratively~~ Refining Computational Artifacts	Creativity and innovation ◦ Communication and collaboration ◦ Research and information fluency ◦ Critical thinking, problem solving, and decision making
6-8.IC.07	Understand and explain the elements of federal, state, and local regulations that relate to digital citizenship (e.g., COPPA, CIPA, state laws, district policies). (Grades 6-8)	Fostering an Inclusive Computing Culture	Digital citizenship
6-8.IC.08	Summarize current events and changes resulting from computing and their effects on education, the workplace, and society. (Grades 6-8)	Fostering an Inclusive Computing Culture	Creativity and innovation ◦ Research and information fluency ◦ Technology operations and concepts
6-8.IC.09	Predict positive and negative social impacts of existing or student created content and computational artifacts (e.g., economic, entertainment, education, political). (Grades 6-8)	Collaborating around Computing	Critical thinking, problem solving, and decision making ◦ Digital citizenship ◦ Technology operations and concepts
9-10.IC.01	Explain the social and economic implications associated with unethical computing practices	Collaborating around Computing	Critical thinking, problem solving,

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	(e.g., software piracy, intrusion, malware, current corporate fraud examples). (Grades 9-10)		and decision making ◦ Digital citizenship ◦ Technology operations and concepts
9-10.IC.02	Discuss trade-offs such as privacy, safety, and convenience associated with the collection and large scale analysis of information about individuals (e.g., social media, online shopping, how grocery/dept. stores collect and use personal data). (Grades 9-10)	Communicating about Computing	Communication and collaboration ◦ Research and information fluency ◦ Digital citizenship ◦ Technology operations and concepts
9-10.IC.03	Understand and explain the impact of artificial intelligence and robotics. (Grades 9-10)	Communicating about Computing	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
9-10.IC.04	Describe how computer science shares features with creating and designing an artifact, such as in music and art. (Grades 9-12)	Communicating about Computing	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
9-10.IC.05	Demonstrate how computing enhances traditional forms and enables new forms of experience, expression, communication, and collaboration (e.g., virtual reality). (Grades 9-10)	Fostering an Inclusive Computing Culture	Creativity and innovation ◦ Communication and collaboration ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
9-10.IC.06	Explain the impact of the digital divide on access to critical information (e.g., education, healthcare, medical records, access to training). (Grades 9-10)	Fostering an Inclusive Computing Culture	Communication and collaboration ◦ Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Digital citizenship
9-10.IC.07	Explain the impact of the digital divide on access to critical information (e.g., education, healthcare, medical records, access to training). (Grades 9-10)	Fostering an Inclusive Computing Culture	Communication and collaboration ◦ Research and information fluency ◦ Critical thinking, problem solving, and

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			decision making ◦ Digital citizenship
9-10.IC.08	Compare the positive and negative impacts of computing on behavior and culture. (Grades 9-10)	Fostering an Inclusive Computing Culture	Communication and collaboration ◦ Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Digital citizenship
9-10.IC.09	Evaluate a computational artifact for its effectiveness for universal access (e.g., compare sample code with accessibility standards, building in access from initial design). (Grades 9-10)	Testing and ~~Iteratively~~ Refining Computational Artifacts	Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
9-10.IC.10	Practice responsible digital citizenship (legal and ethical behaviors) in the use of technology systems and software. (Grades 9-10)	Fostering an Inclusive Computing Culture	Digital citizenship
9-10.IC.11	Explain how computer science fosters innovation and enhances other careers and disciplines. (Grades 6-8)	Communicating about Computing	Communication and collaboration ◦ Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Digital citizenship
9-10.IC.12	Explain the impact of computing on business, manufacturing, commerce, and society. (Grades 9-12)	Fostering an Inclusive Computing Culture	Communication and collaboration ◦ Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Digital citizenship
11-12.IC.01	Understand the ecosystem of open source software development and its impact on global collaboration through an open source software project (e.g., https://codein.withgoogle.com). (Grades 11-12)	Collaborating around Computing	Research and information fluency; Critical thinking, problem solving, and decision making; Digital citizenship;

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			Technology operations and concepts
11-12.IC.02	Debate laws and regulations that impact the development and use of software. (e.g., compare and contrast: licensing versus certification, professional societies, professional code of ethics). (Grades 11-12)	Communicating about Computing	Communication and collaboration ◦ Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Digital citizenship ◦ Technology operations and concepts
11-12.IC.03	Research, analyze, and present how computational thinking has revolutionized an aspect of our culture (e.g., agriculture, communication, work, healthcare, music, art). (Grades 11-12)	Fostering an Inclusive Computing Culture	Creativity and innovation ◦ Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Digital citizenship ◦ Technology operations and concepts
11-12.IC.04	Analyze the role and impact of government regulation on privacy and security. (Grades 11-12)	Fostering an Inclusive Computing Culture	Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Digital citizenship
11-12.IC.05	Debate how the issues of equity, access, and power relate to the distribution of computing resources in a global society. (Grades 11-12)	Fostering an Inclusive Computing Culture	Communication and collaboration ◦ Research and information fluency ◦ Critical thinking, problem solving, and decision making
11-12.IC.06	Identify and evaluate the beneficial and harmful effects of computing innovations. (Grades 11-12)	Developing and using Abstractions	Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Digital citizenship
11-12.IC.07	Practice responsible digital citizenship (legal and ethical behaviors) in the use of technology systems and software. (Grades 11-12)	Fostering an Inclusive Computing Culture	Digital citizenship
11-12.IC.08	Describe how computer science shares features with creating and designing an artifact such as	Communicating about Computing	Critical thinking, problem solving,

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			and decision making ◦ Technology operations and concepts
11-12.IC.09	Explain the impact of computing on business, manufacturing, commerce, and society. (Grades 9-12)	Fostering an Inclusive Computing Culture	Communication and collaboration ◦ Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Digital citizenship
11-12.IC.10	Summarize how computer automation and control is transforming society and the global economy (e.g., financial markets, transactions, predictions). (Grades 11-12)	Fostering an Inclusive Computing Culture	Communication and collaboration ◦ Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Digital citizenship

	K-12 CS Standards - Networks and Communication (NC) *The student will be able to:*	Computational Thinking Framework Practice	ISTE Standard
3-5.NC.01	Demonstrate how a device on a network sends and receives information. (Grades 3-5)	Developing and using Abstractions	Technology operations and concepts
6-8.NC.01	Simulate the flow of information as packets on the Internet and networks (e.g., model using strings and paper, note passing). (Grades 6-8)	Communicating about Computing	Communication and collaboration ◦ Technology operations and concepts
6-8.NC.02	Compare and contrast the trade-offs between physical (wired), wireless, and mobile networks (e.g., speed, security, and cost). (Grades 6-8)	Communicating about Computing	Communication and collaboration ◦ Technology operations and concepts
9-10.NC.01	Describe the underlying process of Internet based services. (e.g., information flow in a global network, servers and clients, cloud services, secure versus insecure communication). (Grades 9-10)	Communicating about Computing	Communication and collaboration ◦ Research and information fluency ◦ Critical

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			thinking, problem solving, and decision making ° Technology operations and concepts
9-10.NC.02	Illustrate the basic components of computer networks, protocols and routing (e.g., team based activities which may include drawing a diagram of a network including routers, switches, local networks, and end user devices; creating models with string and paper; CS unplugged activities). (Grades 9-10)	Developing and using Abstractions	Communication and collaboration ° Research and information fluency ° Critical thinking, problem solving, and decision making ° Technology operations and concepts
11-12.NC.01	Simulate and discuss the issues that impact network functionality (e.g., use ns3 or other free network simulators). (Grades 11-12)	Developing and using Abstractions	Creativity and innovation ° Research and information fluency ° Communication and collaboration ° Technology operations and concepts
11-12.NC.02	Examine how encryption is essential to ensuring privacy and security over the internet. (Grades 11-12)	Communicating about Computing	Communication and collaboration ° Research and information fluency ° Critical thinking, problem solving, and decision making ° Technology operations and concepts

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	K-12 CS Standards - Algorithms and Programming (AP) *The student will be able to:*	Computational Thinking Framework Practice	ISTE Standard
K-2.AP.01	Construct and test problem solutions using a block-based visual programming language, both independently and collaboratively (e.g., pair programming). (Grades K-5)	Creating Computational Artifacts	Creativity and innovation ◦ Critical thinking, problem solving, and decision making
K-2.AP.02	Create a design document to illustrate thoughts, ideas, and stories in a sequential manner (e.g., storyboard, mind map). (Grades K-2)	Designing and Representing Computational Problems	Creativity and innovation
K-2.AP.03	Construct an algorithm to accomplish a task, both independently and collaboratively. (Grades K-5)	Developing and using Abstractions	Creativity and innovation ◦ Critical thinking, problem solving and decision making ◦ Communication and collaboration
K-2.AP.04	Follow the sequencing in an algorithm. (Grades K-2)	Testing and ~~Iteratively~~ Refining Computational Artifacts	Critical thinking, problem solving and decision making
3-5.AP.01	Identify and understand ways in which teamwork and collaboration can support problem solving and the software design cycle. (Grades 3-5)	Collaborating around Computing	Creativity and innovation ◦ Communication and collaboration ◦ Critical thinking, problem solving, and decision making
3-5.AP.02	Construct and test problem solutions using a block-based visual programming language, both independently and collaboratively (e.g., pair programming). (Grades K-5)	Creating Computational Artifacts	Creativity and innovation ◦ Critical thinking, problem solving, and decision making
3-5.AP.03	Generate a list of sub-problems to consider while addressing a larger problem. (Grades 3-5)	~~Designing and Representing~~ Recognizing and Defining Computational Problems	Critical thinking, problem solving, and decision making
3-5.AP.04	Understand that computer program design is an iterative process that includes the following steps: define the problem, generate ideas, build a program, test the program, improve the program. (Grades 3-5)	~~Designing and Representing~~ Recognizing and Defining Computational Problems	Creativity and innovation ◦ Research and information fluency ◦ Critical thinking, problem solving and decision making ◦ Technology operations and concepts

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3-5.AP.05	Understand, explain, and debug the sequencing in an algorithm. (Grades 3-5)	Testing and Iteratively Refining	Critical thinking, problem solving and decision making
3-5.AP.06	Construct and test problem solutions using a block-based visual programming language, both independently and collaboratively (e.g. pair programming). (Grades K-5)	Creating Computational Artifacts	Creativity and innovation ◦ Critical thinking, problem solving, and decision making
3-5.AP.07	Construct an algorithm to accomplish a task, both independently and collaboratively. (Grades K-5)	Developing and using Abstractions	Creativity and innovation ◦ Critical thinking, problem solving and decision making ◦ Communication and collaboration
6-8.AP.01	Solicit, evaluate, and integrate peer feedback as appropriate to develop or refine a product. (Grades 6-8)	Collaborating around Computing	Communication and collaboration ◦ Critical thinking, problem solving, and decision making
6-8.AP.02	Compare different algorithms that may be used to solve the same problem by time and space efficiency. (Grades 6-8)	Communicating about Computing	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
6-8.AP.03	Interpret, modify, and analyze content specific models used to run simulations (e.g., ecosystems, epidemics, spread of ideas). (Grades 6-8)	Creating Computational Artifacts	Creativity and innovation ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
6-8.AP.04	Apply an iterative design process (define the problem, generate ideas, build, test, and improve solutions) in problem solving, both individually and collaboratively. (Grades 6-8)	Creating Computational Artifacts	Creativity and innovation ◦ Communication and collaboration ◦ Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
6-8.AP.05	Create, analyze, and modify control structures to create programming solutions. (Grades 6-8)	Creating Computational Artifacts	Creativity and innovation ◦ Communication and

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			collaboration ◦ Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
6-8.AP.06	Predict the outcome of an algorithm and step through it to verify your predictions. (Grades 6-8)	Creating Computational Artifacts	Communication and collaboration ◦ Critical thinking, problem solving, and decision making
6-8.AP.07	Decompose a problem into sub-problems and demonstrate how the parts can be synthesized to create a solution. (Grades 6-8)	Developing and using Abstractions	Communication and collaboration ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
6-8.AP.08	Evaluate the correctness of a program by collecting and analyzing data generated from multiple runs of the program. (Grades 6-8)	Testing and ~~Iteratively~~ Refining Computational Artifacts	Communication and collaboration ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
6-8.AP.09	Use debugging and testing to improve program quality. (Grades 6-8)	Testing and ~~Iteratively~~ Refining Computational Artifacts	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
9-10.AP.01	Design and develop a software artifact by leading, initiating, and participating in a team (e.g. , pair programming, agile software development). (Grades 9-12)	Collaborating around Computing	Creativity and innovation ◦ Communication and collaboration ◦ Critical thinking, problem solving, and decision making
9-10.AP.02	Demonstrate how diverse collaboration, both inside and outside of a team, impacts the design and development of software products (e.g., students show their own artifacts and demonstrate/reflect how diverse collaboration makes a product better). (Grades 9-12)	Collaborating around Computing	Communication and collaboration ◦ Research and information fluency ◦ Critical thinking, problem solving, and

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			decision making
9-10.AP.03	Compare a variety of programming languages available to solve problems and develop systems. (Grades 9-10)	Collaborating around Computing	Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
9-10.AP.04	Explore security issues that might lead to compromised computer programs (e.g., ambiguous function calls, lack of error checking of the input, buffer overflow, SQL injection attacks, denial of service attacks). (Grades 9-12)	Communicating about Computing	Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
9-10.AP.05	Classify and define the different types of software licenses in order to understand how to apply each one to a specific software example. (Grades 9-12)	Fostering an Inclusive Computing Culture	Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Digital citizenship ◦ Technology operations and concepts
9-10.AP.06	Understand the notion of hierarchy and abstraction in high-level languages, translation, instruction sets, and logic circuits. (Grades 9-10)	Fostering an Inclusive Computing Culture	Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
9-10.AP.07	Explore issues surrounding mobile computing by creating a mobile computing application (e.g., App Inventor). (Grades 9-10)	Creating Computational Artifacts	Creativity and innovation ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
9-10.AP.08	Create software solutions by applying analysis, design, implementation, and testing techniques. (Grades 9-10)	Creating Computational Artifacts	Creativity and innovation ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts

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9-10.AP.09	Demonstrate code reuse by creating programming solutions using APIs and libraries (e.g., using text-to-speech in App Inventor, using Twitter API). (Grades 9-10)	Creating Computational Artifacts	Creativity and innovation ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
9-10.AP.10	Illustrate the flow of execution and output of a given program (e.g., flow and control diagrams). (Grades 9-10)	Creating Computational Artifacts	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
9-10.AP.11	Illustrate how mathematical and statistical functions, sets, and logic are used in computation. (Grades 9-10)	Creating Computational Artifacts	Research and information fluency ◦ Critical thinking, problem solving, and decision making
9-10.AP.12	Design algorithms using sequence, selection, iteration, and recursion. (Grades 9-10)	Designing and Representing Computational Problems	Creativity and innovation ◦ Critical thinking, problem solving, and decision making
9-10.AP.13	Explain, represent, and understand natural phenomena using modeling and simulation (Grade 9-10).	Designing and Representing Computational Problems	Creativity and innovation ◦ Critical thinking, problem solving, and decision making
9-10.AP.14	Describe the concept of parallel processing as a strategy to solve large problems. (Grades 9-10)	Designing and Representing Computational Problems	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
9-10.AP.15	Compare and evaluate software development processes used to solve problems (e.g., waterfall, agile). (Grades 9-10)	Designing and Representing Computational Problems	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
9-10.AP.16	Decompose a complex problem into simpler parts using predefined functions and parameters, classes, and methods. (Grades 9-10)	Developing and using Abstractions	Critical thinking, problem solving, and decision making
9-10.AP.17	Demonstrate the value of abstraction to manage problem complexity. (Grades 9- 10)	Developing and using Abstractions	Creativity and innovation ◦ Critical thinking, problem solving, and decision making ◦

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			Technology operations and concepts
9-10.AP.18	Evaluate and improve program quality using various debugging and testing methods, and examine the difference between verification and validation. (Grades 9-12)	Testing and ~~Iteratively~~ Refining Computational Artifacts	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
9-10.AP.19	Evaluate programs written by others for readability and usability. (Grades 9-10)	Collaborating around Computing	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts ◦ Communication and Collaboration
11-12.AP.01	Analyze the notion of intelligent behavior through programs that learn and adapt, play games, do image recognition, perform text analysis, and control the behavior of robots. (Grades 11-12)	Communicating about Computing	Creativity and innovation ◦ Research and information fluency ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
11-12.AP.02	Create collaborative software projects using version control systems, Integrated Development Environments (IDEs), and collaborative tools. (Grades 11-12)	Collaborating around Computing	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts ◦ Communication and collaboration
11-12.AP.03	Demonstrate an understanding of the software life cycle process (e.g., participate on a software project team). (Grades 11-12)	Collaborating around Computing	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts ◦ Communication and collaboration
11-12.AP.04	Modify an existing program to add additional functionality and discus the positive and negative implications (e.g., breaking other functionality). (Grades 11-12)	Communicating about Computing	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
11-12.AP.05	Explain the value of heuristic algorithms to approximate solutions for intractable problems.	Designing and Representing	Critical thinking, problem

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	(Grades 11-12)	Computational Problems	solving, and decision making ◦ Technology operations and concepts
11-12.AP.06	Decompose a computational problem through data abstraction and modularity. (Grades 9-12)	Designing and Representing Computational Problems	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
11-12.AP.07	Examine algorithms critically, and design an original algorithm (e.g., adapt, remix, improve). (Grades 11-12)	Developing and using Abstractions	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
11-12.AP.08	Evaluate efficiency, correctness, and clarity of algorithms. (Grades 11-12)	Developing and using Abstractions	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
11-12.AP.09	Compare and contrast simple data structures and their uses (e.g., arrays, lists, stacks, queues, maps, trees, graphs). (Grades 11-12)	Developing and using Abstractions	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
11-12.AP.10	Decompose a problem by creating functions and classes. (Grades 11-12)	Developing and using Abstractions	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
11-12.AP.11	Use variable scope and encapsulation to design programs with cohesive and decoupled components. (Grades 9-12)	Designing and Representing Computational Problems	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
11-12.AP.12	Classify problems as tractable, intractable, or computationally unsolvable. (Grades 11-12)	Developing and using Abstractions	Critical thinking, problem solving, and decision making ◦ Technology operations and concepts
11-12.AP.13	Understand and explain the use of concurrency (e.g., separate processes into threads and	Designing and Representing	Critical thinking, problem

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	divide data into parallel streams, self sort by height). (Grades 11-12)	Recognizing and Defining Computational Problems	solving, and decision making ◦ Technology operations and concepts
11-12.AP.14	Evaluate the qualities of a program such as correctness, usability, readability, efficiency, portability, and scalability through a process such as a code review. (Grades 11-12)	Testing and ~~Iteratively~~ Refining Computational Artifacts	Communication and collaboration ◦ Critical thinking, problem solving, and decision making ◦ Technology operations and concepts